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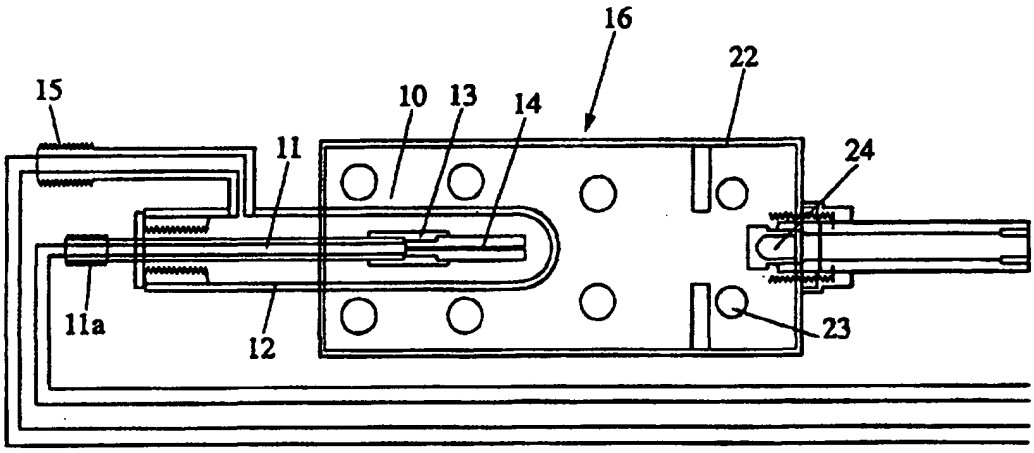

(57) Abstract

An agricultural flame cultivator is disclosed comprising a burner construction of bunsen burner type having a gas inlet, a mixing chamber and burner outlet, the burner outlet including a gauze or mesh member insert bordering the mixing chamber at or near the burner outlet for directing flame into a zone of treatment within the cultivator and an additional burner positioned to direct additional heat into the same zone of treatment to boost heat in the zone of treatment. A vaporiser for LPG gas is also disclosed in which metering means for controlling the flow of liquid fuel into the vaporiser, the metering means being located in the vaporiser chamber or closely adjacent thereto to minimise the volume of fuel between the metering means and the heating means thus ensuring complete vaporisation of the liquid fuel and allowing conventional pressure regulation of the gaseous fuel. In a modified form, the vaporiser is fitted with a metering means that is adjustable. In a further modified form the metering means includes a relatively large orifice to minimise the risk of blockage. An implement for a flame cultivator is disclosed including deflection foils or vanes useful to direct heated air down to ground level in use.

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IMPROVED CONCENTRATED HEAT AGRICULTURAL FLAME CULTIVATOR APPARATUS

BACKGROUND OF THE INVENTION

This invention relates to combustive plant pest and weed killing apparatus, particularly for thermally killing weeds and plant pests near plants of a valuable crop such as cotton, corn or lucerne. Specifically, the invention relates to an improved gas burner construction, an associated implement and a modified vaporiser arrangement.

Chemical herbicides and pesticides are commonly used in agriculture, however, there is an ever growing concern about the degradation of the environment and the crops as a result of the use of such chemicals.

The use of combustive apparatus in an agricultural implement requires relatively large volumes of fuel to be supplied to a relatively large number of burners given that the implement is expected to quickly treat a large commercial tract of land.

The large capacity burners inevitably lead to problems in maintaining an adequate supply of fuel to the burners at optimum combustion efficiency.

There have been various apparatus disclosed in the prior art, directed to the provision of vaporisers for such machinery, including US Patent No. 3357474 (Pivonka) which is directed to an LPG burner/vaporiser and is designed to ensure vaporisation of vaporisable fuel, such as butane/propane gas mixtures with the object of burning fuel at a high rate relative to the size of the burner.

Similarly, US Patent No. 3645664 (Clinton) relates to a vaporiser which is claimed to operate at greater efficiency by supplying vaporised propane fuel to burners in a manner that ensures the fuel is sufficiently burned with little or no smoke being released to the atmosphere.

Flame treatment or flaming in agricultural applications is practiced to control weeds and pests. Flaming involves the application of a high intensity heat for a short period of time but sufficient to create cell damage in the leaves and stems of the weeds and to kill pests such as bacteria, weevils, insects or fungus spores or the like that are likely to attack the valuable crop plants.

Flaming treatment is also utilised to a limited extent in relation to heating of asphalt on asphalt roads, and like surfaces where large quantities of heat are applied to the surface over a relatively large surface area.

Problems are experienced with flaming treatments in crops including leaf damage to the crop plants caused by overheating.

US Patent No. 5189832 (Hoek et al) discloses one proposal to reduce the heat damage to the plant by creating a horizontal cool air curtain near the base of the plant to restrict rising hot air which can tend to damage the leaves.

Current LPG burning apparatus known to the applicant, examples of which are referred to above, exhibit a problem of uneven vaporisation of the liquid fuel at the vaporiser.

This problem possibly results from the need to regulate the flow of the pressurised liquid fuel prior to vaporisation and prior to it being fed to the vaporiser.

This inevitably leads to at least partial vaporisation of the liquid down stream of the regulator and a resultant take up of heat by the vaporising liquid and resulting in freezing of the lines and fittings, as well as the regulator valves.

This means that the vaporiser receives fuel which may be partially vaporised, or in some instances fully vaporised, and in other instances still fully liquid depending upon the temperature of the downstream line between the valve and the vaporiser.

The temperature of the fuel in the line may vary between the range of ambient temperature of say 25°C and the boiling temperature of the propane fuel which is -420°C.

Such a wide temperature range of feed to the vaporiser may lead to either inadequate vaporisation of the fuel or in overheating of the fuel to high temperatures. It has been found that inadequate vaporisation will lead to ineffective or inefficient burning of the fuel in most instances, which in turn will cause high fuel consumption and lower than optimum burner temperatures.

It has been found that the burner temperature in flaming equipment should be kept at a constantly high level if at all possible as this is conducive to orderly operating of the flaming equipment over an extended period of time

requiring only minimum adjustment to the burners and to the vaporisers for a given speed of travel over the ground by the implement.

Flaming treatment of plant weed does not require actual burning of the plant weed, but merely involves a sudden increase of temperature in the leaf cells of the plant weed to say 50 to 70°C. This leads to a withering of the leaves and stems of the plant weed and ultimately results in the death of susceptible weeds.

Thus the implement may have a ground speed of up to 7 km per hour depending upon various factors such as moisture content, ground temperature and burner flame temperature, as well as the size of the plant weeds.

Similar comments apply in relation to the use of the implement as a pest killing device.

US Patent No. 3486497 (Pivonka) addresses the problem of achieving a large coverage area with the flaming technique by discharge of a fine stream of liquid fuel at high velocity to an area to create a wide spread of fuel directed at ground level. This device is particularly used for burning off on roadsides and in irrigation channel clearing.

Thus, in this arrangement, the fuel is vaporised in the atmosphere after being released and ignition and burning takes place as the liquid vaporises.

SUMMARY OF THE INVENTION

The present invention has as one objective to provide a vaporiser for LPG fuel such as propane or propane/butane mix in which the abovementioned problems in the prior art are at least partially met by achieving improved gas burner efficiency.

It is a further objective to provide an LPG fuel vaporiser for use on high heat output implements, and apparatus useful in the control of weeds and pests, particularly but not exclusively in agricultural situations.

The apparatus has also been found useful in the control of weeds in public areas or pathways or the like.

It is a still further objective of the present invention to ensure that heat is evenly applied to a maximum area of the zone for each burner mounted in an implement. It has been found that existing gas burner designs tend to concentrate the heat into rows that are relatively narrow thereby leading to under treatment of portions of the ground or crop.

Furthermore, in relation to the vaporiser, it is proposed to provide a lesser number or a single vaporiser of larger capacity capable of vaporising a large volume of fuel for a larger number of burners. This has the advantage of efficiency and also allows for the use of a larger orifice or orifices in the metering means thereby minimising the likelihood of blockages in the vaporiser orifices.

VAPORISER

There is provided according to the present invention, a vaporiser for liquid petroleum gas (LPG) fuel such as propane or propane/butane mix suitable for use with flame, weed and pest control apparatus in which the vaporiser includes a chamber and an associated heater means for receiving fuel and adapted to be heated by the heater means to vaporise the fuel in the chamber, metering means for limiting the volume of liquid fuel flow to the chamber, the metering means being located in the chamber or closely adjacent thereto to minimise the volume of fuel between the metering means and the heating means.

Optionally, the metering means may include adjustment means to enable adjustment of the liquid flow through the metering means.

In a further aspect of the invention, there is provided a vaporiser for LPG fuel such as propane or propane/butane mix, having a boiling point of less than 0°C, the vaporiser including gas burner heating means, a chamber for receiving liquid LPG gas and a metering means within or adjacent to the chamber for limiting the flow of fuel into the chamber when heated, whereby controlled vaporisation of the fuel is achieved to enable conventional pressure regulation of the gaseous fuel for feeding to a thermal weed or pest control implement.

By locating the metering means within the chamber, it will be found that problems associated with icing of the fuel pipeline and fittings including flow regulators are minimised such that a constant supply of fully vaporised fuel is

supplied by the vaporiser.

Conveniently the vaporiser may be associated with a gas burner or burners supplied with fuel that has been vaporised by the vaporiser.

In a further aspect of the present invention it is proposed to provide a vaporiser having a larger capacity and able to vaporise fuel for a larger number of burners which in turn enables the use of a larger metering orifice not so prone to such blockages. Furthermore, any blockages that may still occur are easier to clear.

In a still further aspect of the present invention there is provided a vaporiser for LPG fuel such as propane or propane/butane comprising an elongate tubular member and associated heater means for receiving said LPG fuel and adapted to be heated by the heater means to vaporise the fuel, the fuel being admitted to the tubular member by metering means having a relatively large orifice size.

The vaporiser has a larger than normal orifice or orifices thereby minimising the possibility of blockage by dirt particles or the like in the fuel.

Furthermore, the vaporiser has sufficient capacity to supply gas to a large bank of burners such as used in an agricultural flame cultivator of the type described in greater detail in our earlier file application referred to above.

Continuity of supply of fully vaporised fuel enables conventional gas pressure and flow regulation techniques to be employed on the outlet side of the vaporiser, thereby enabling, in turn, operation of the gas burners at their optimum performance level over an indefinite extended period of time with little or no variation in flow pattens in the vaporised fuel.

The vaporiser is conveniently associated with the supply of gas to a bank of say 3 or 6 burners mounted upon a ground engaging implement and adapted to be drawn behind a tractor. Of course the implement may be a self driven mobile unit.

BURNER

The burners currently being used are large Bunsen type burners in which vaporised gases is mixed with air and burned to form a relatively hot flame of between 900°C to 1200°C. It has been established in testing of the equipment

as illustrated in our earlier application that the temperature of the flame quickly dissipates despite modification of the mouth of the burners to be elongated in a horizontal plane relative to the ground surface to be treated. This necessitates the placement of burners side by side relatively close together in order to avoid strips of ground being untreated through lack of heat.

It has been surprisingly found according to the invention that a wider area of ground surface can be treated for a given size of burner by the provision of a gauze or mesh member inserted within the mixing chamber at or near the burner mouth.

The gauze or mesh has the effect of improving the diffusion of the air/gas mix by decreasing the velocity of the mixture within the chamber, thereby enabling a greater spread of heat over a wide area near the burner.

Conveniently the gauze or mesh material is formed to have a concave inward surface completely extending across the burner chamber.

Preferably the size of the mesh holes should not exceed 2mm for best results.

It is has been found that such a burner construction in conjunction with a trailing shroud or skirt will provide an even spread of high temperature burning gases beneath the shroud and has been found particularly effective in the control of weeds and pests associated with lucerne and like crops.

The mesh is of temperature resistant material of the type marketed under the trade mark INCANOL.

It has been found that such a burner construction in conjunction with a trailing shroud or skirt will provide an even spread of high temperature burning gases beneath the shroud and has been found particularly effective in he control of weeds and pests associated with crop cultivation. However it has been found at least in some applications that the provision of the gauze or mesh insert member does compromise the fierceness of the resultant flame at the burner mouth both in terms of velocity or impact of the flame at the point of application to the ground surface. Thus at least in some instances the heat of combustion emanating from the burner is not always properly focussed at the ground area being treated.

It is an objective of the present invention to at least minimise the abovementioned apparent shortcomings by providing an even, focussed flame temperature burner arrangement in an agricultural flame cultivator.

According to a further aspect of the present invention, there is provided an improvement in the agricultural flame cultivator comprising a burner construction of the bunsen burner type having a gauze or mesh member insert within the mixing chamber at or near the burner mouth, the burner being arranged to direct the flame into a zone of treatment, the improvement comprising the provision of a bunsen burner positioned to direct additional heat into the same zone of treatment to achieve improved focussing and maintenance of heat at ground level in the zone of treatment.

There is also provided according to the present invention, an improved flame cultivator as described in the preceding paragraph, wherein said gauze or mesh insert is configured concave inwardly and is located or arranged closely adjacent to a trailing shroud or skirt with the additional bunsen burner being positioned above and closely adjacent to said insert type bunsen burner in order to enhance the flame velocity in the vicinity of the insert burner.

Preferably the bunsen burner providing additional heat is of standard construction and does not include a gauze or mesh insert. Thus apart from the additional heat provided in the zone of treatment the flame is directed with greater velocity and focus than that provided by a burner with gauze or mesh insert. The additional heat will provide greater dwell time for weed and pest control in a wide variety of crop situations.

IMPLEMENT

The implement may take many forms depending upon the purpose for which it is used. In conventional row cropping the implement is used in weed control, for example cotton or maize corn or similar crops which are heat tolerant and pre-emergent crops. The implement may contain burner units adapted to travel between the rows of plants with shielding means associated with the burners to direct the heat at the ground weeds around the base of the plant and to shield the plant leaves from damage created by heat radiation or hot air draughts.

In an alternative arrangement the implement may incorporate a metal blanket or shroud trailing behind gas jets. The implement is adapted to travel over a recently cropped field such as lucerne or the like, or pasture, wherein unignited gas is directed to lay at ground level beneath the metal blanket and ignited at the trailing edges of the blanket so as to burn weeds and kill pests at the base of the crop stalks.

In the case of lucerne, the crop will regrow for future cropping and should be unaffected by the heat provided that the quantity of heat is not excessive, and the timing of the treatment does not take place during the new growth of the crop.

In specific instances the implement may be a relatively large tractor drawn device suitable for treatment of large areas under cultivation. Alternatively, the implement may be relatively small having a single or small array of burners suitable for manual operation.

Still further, the burner combination incorporating the gauze or mesh member coupled with the extra burner is useful for hand held operation in areas which may be space restricted or inaccessible for normal machinery.

The invention will be described in greater detail, having reference to the accompanying drawings in which :-

Figure 1 is a typical arrangement of a tractor drawn flame cultivator fitted with a vaporiser of the present invention.

Figures 2 and 3 shows the vaporiser components in which Figure 2 is the internal vaporisable liquid inlet tube and metering unit, and Figure 3 is the assembly of the type and vaporisation chamber.

Figure 4 is a schematic diagram of the fuel lines to and from the vaporisers, the gas regulation control valve and the burner arrangements.

Figure 5 is a schematic view of a vaporiser with attached burner.

Figure 6 is a schematic side view showing an alternative implement for a flame cultivator.

Figure 7 is a schematic view of an alternative form of vaporiser with attached burner.

Figure 8 is a schematic frontal view of the implement of Figure 1 showing the burner groups in modules.

Figure 9 is a schematic side view of an alternative vaporiser with adjustable metering valve therein.

Figure 10 shows schematically a typical flame cultivator using banks of burners and a modified vaporiser.

Figure 11 is an end view of a modified burner outlet.

Figure 12 is a side view of a flame cultivator implement.

Figure 13 is a side view of a flame cultivator implement with modified burner arrangement.

Figure 14 is a plan view of a bunsen burner of the same type depicted in Figure 4.

Figure 15 is a sectional side view of modified flame cultivator implement.

Figure 16 is a part side view of the implement of Figure 15.

Figure 17 is a side sectional view of a modified burner construction.

Figure 18 is a front elevational view of the burner construction of Figure 17.

VAPORISER

With reference to Figures 1, 2, 3, 5 and 7, there is shown constructional features of the vaporiser and alternative arrangements of the burner to supply heat to the vaporiser.

Figure 2 shows the inlet tube which is connected directly to the supply tank for the liquid petroleum gas (LPG) which is preferably propane or a mixture of propane/butane.

Propane has a boiling point of -42°C and therefore at ambient temperatures it must be stored under pressure which may vary between 40 and 120 psi depending upon the temperature.

Butane has a higher boiling point temperature and therefore the propane/butane mix will have a higher boiling point temperature than pure propane, and will therefore generate lower pressures.

The fuel is carried under pressure from the storage tank to the vaporiser 10 and is released into the chamber through an orifice 14 releasably held on the end of the inlet tube 11 by fitting 13. The inlet tube 11 is connected to a hose leading to the storage tank by fitting 11a.

Upon heating of the chamber 12 by a flame, the released liquid from the

inlet tube 11 is vaporised in the high temperature environment in the chamber 12, the gas is then piped away through gas fitting 15.

The resulting expansion of the fuel into the chamber does absorb large amounts of heat, which is supplied by the vaporiser burner 16 in Figure 5, or burner 17 in Figure 7.

The metered orifice member 14 is of predetermined size to supply sufficient fuel in its liquid phase to supply the demand of a bank of burners operating on that particular circuit of up to say 6 burners as shown in Figure 8.

The gas is fed into a manifold pipe and then fed to the burners through pressure regulator valve 20 or 21.

The valve 20 may be a low volume flow regulator whilst valve 21 may be of a high volume flow regulator, depending upon the number of burners that are actually operating on the implement.

Each burner may include a stop valve for controlling flow of gas to each individual burner.

Stop valves are also provided to control flow of gas to each bank of burners.

With reference to Figure 9, this shows a modified vaporiser in which a needle valve assembly 29 is arranged at the incoming end of the liquid fuel line 11. The needle valve assembly includes a needle valve 25, socket head 26 and lock nut 28 to lock the needle in a desired setting.

The valve is threaded to allow movement of the needle point relative to the seat 11c and thereby control flow of incoming liquid 11a to the tube 11. A cap 27 may be provided to cover the socket head 26.

With reference to Figure 10, this shows schematically a typical flame cultivator utilising four banks of burners 70, each bank being occupied by four burners 71. The burners are supplied with LPG fuel from the tank 60 controlled by stop valves 61, 62 which are adapted to release fuel into vaporiser tube 63 which is preferably an elongate small bore tube having a metering orifice at each end thereof (not shown). The volume of fuel consumed by the burners requires that the fuel be vaporised prior to being distributed to the burners in order to avoid inefficient use of the fuel and allows closer regulation of fuel flows to the burners.

Control of fuel flow is essentially in two stages, the first stage involving firing of the pilot burner 64 to preheat the vaporiser and fuel therein, and then the second stage of ignition of all burners or a predetermined number of the burners in the other banks. The vaporiser 63 absorbs sufficient heat to convert all fuel requirements for all of the burners into gas for regulation by regulator valve 66.

The flow of gas from the regulator to the burner bank 70 is controlled by stop valve 65. Because of the relatively large capacity of the vaporiser tube 63, the size of the orifices (which may be fixed or adjustable) measuring the fuel to the tube is relatively large, preferably, being greater than 1mm thereby minimising the possibility of blockage occurring in the metering tube.

Vaporisation is achieved by an independent burner which is controlled by the temperature of the vapour in the outlet tube of the vaporiser chamber and before entering regulators. This protects the regulators from being subjected to expensive heat causing premature failure of regulators.

The flow of liquid from the fuel tank is controlled by a solenoid valve.

As the liquid flow into the vaporiser is controlled by a correctly sized orifice 11(c), 14 it is also affected by the pressure between the vaporiser outlet 15 and the regulator, this pressure is approximately the difference between the liquid pressure in the tank and the downstream pressure between regulator and burners. However, this pressure varies according to the amount of vapour being used. If usage exceeds the capabilities of the orifice to allow enough liquid to pass through to the vaporiser and the heat is still applied to vaporiser chamber then the temperature will rise. Temperature control switch will then cut off fuel to the vaporiser burner 63 allowing cooling of vaporiser and vapour supply.

The combination of orifice size and pressure and temperature control ensure safe and efficient operation of equipment.

IMPLEMENT

With reference to Figure 1, this shows a typical tractor drawn implement which may be mounted on the hitch of the tractor with the assistance of a jockey wheel 40 and may be lowered about the two bar linkage 41 supporting the ground engaging implement through link 42. The burners 17 are located around the deflector plates 43 to direct heat at the ground level and beneath the

deflector plate to ensure that upward flow of heat from the unit is minimised. The ground engaging units 43 are supported on a main cross bar 44, which include pivot points 45, as shown in Figure 8, enabling banks of units of the ground engaging implement to be pivoted back on itself to reduce the width of the implement for road use.

With reference, to Figure 6 this shows a modified implement incorporating a burner unit 50 mounted transversely of the implement at 51. The burner unit 50 has spaced jets 52 for directing unignited gas into a chamber formed between the implement and the ground and then to travel back along the blanket portion 53, which typically may be of approximately 1 metre depth.

The arrangement is such that the unignited gas can be ignited at the trailing edge 53a of the metal blanket 53.

The blanket has the effect of stabilising the gaseous mixture beneath the blanket and allowing it to settle at the ground level where ignition of the gas will have maximum effect.

The implement may be supported on the three bar linkage of a normal farm tractor through support beam 54 with the ground engaging implement being supported on chains 55.

Figure 5 shows a modified form of a vaporiser in which the vaporisation chamber 10 is mounted diametrically opposite the burner jet 24 mounted within the burner casing 16.

It has been found that the heating effect is maximised with this burner and vaporiser arrangement within the burner housing, and allows maximisation of the heating effect in the vaporisation chamber.

A further practical arrangement of the burner and associated implement will now be described with reference to Figures 11, 12, 17 and 18 of the accompanying drawings.

BURNER

The burner 71 is conveniently formed from a thin tubular sheet metal preferably heat resistant having one end pressed to form an oblong opening 78 in which is mounted a gauze or mesh member 77 also of heat resistant material. A gas jet or jets 72 is/are mounted in the burner body 71 and an air inlet is provided at the back of the burner and covered by similar mesh material 74

effective in preventing draughts and consequent "burning back" of the gas flame and ingress of foreign materials into the burner chamber.

The burner outlet 78 is covered with gauze preferably made from Incanol (Trade Mark) or similar heat resistant material. The surface of the gauze is depressed inwardly preferably forming a concave curved inwardly facing surface over the burner mouth. It has been surprisingly found that this gives a controlled burn flame in which the area of high temperature surrounding each burner is maximised thereby minimising the disadvantages of previous burner designs known to the applicant.

The burners are mounted to project approximately horizontally with the implement 73 including a deflector portion 80 deflecting flame and heat downwardly towards the ground surface.

An aperture or apertures 81 may be located in the deflector to allow partial escape of heat onto the absorber 63 wherever it is fitted.

The implement is fitted with ground engaging skids 79 or the like. The skids are spaced according to particular crop requirements.

With reference to Figures 13, 14 and 15, the burner 17 has a flared outlet housing 100 for directing flame in a relatively wide area at a relatively high velocity.

This burner 17 is preferably mounted atop the shroud member 73 on the cultivator shown in Figure 13. The burner 17 is mounted with the mouth of the burner directed through an aperture in the shroud 73 and adapted to impinge flame into the similar zone of treatment as that treated by the burner 71 mounted beneath the shroud and including a gauze insert 77. Apart from the addition of the burner 17 mounted on the shroud member 73, the construction of the cultivator is similar to that shown in Figure 6 herein. It will be appreciated that the number of burners 17 can be varied according to the requirements of the particular situation which is controlled by the temperature of the gases concentrated beneath the shroud member 73, and other factors such as the nature of the application including the crop to be treated, the amount of moisture and surrounding the crop material.

The burner 17 produces a flame which has a higher temperature, and higher velocity flame which acts as a booster when combined with the gauze

burner and produces a hotter flame spread over a relatively wide area in the zone of treatment beneath the shroud member. It will be appreciated that the shroud member is an optional feature which will assist in the focussing of the heat down to ground level and maintaining the heat in the area where it is most useful in lucerne/pasture cropping. It will be appreciated that the burner construction may be varied according to the needs, however it has been found that the burner should be of open construction without the gauze or mesh insert.

The construction of the body of the cultivator may be varied according to whether it will be used for the treatment of row crops such as cotton or maize for example, and lucerne or like pasture crops.

With reference to Figures 15 and 16, a modified implement is shown with a burner 71 including a gauge member 77 over the outlet as previously described and a booster burner 17 adjacent thereto in an implement frame 100 including air deflector foils 101 as shown to maintain the hot air draught directed downwardly toward the ground surface. Figure 16 shows an implement with a side wind break member 103.

THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. A gas burner arrangement for a flame, weed and pest control apparatus comprising a burner of bunsen burner type having a body including an inlet for gaseous fuel and air and a burner outlet, the burner being arranged to direct flame out of the outlet wherein the burner includes a gauze or mesh insert member mounted within and extending across to cover the burner outlet, the burner being arranged to direct heat into a zone of treatment.

2. A gas burner as claimed in Claim 1, wherein an additional booster burner is mounted adjacent to and above said burner positioned in operation to enhance the flame velocity and flame spread into the zone of treatment.

3. A vaporiser for liquid petroleum gas (LPG) fuel such as propane or propane/butane mix suitable for use with flame, weed and pest control apparatus in which the vaporiser includes a chamber and an associated heater means for receiving fuel and adapted to be heated by the heater means for receiving fuel and adapted to be heated by the heater means to vaporise the fuel in the chamber, metering means for limiting the volume of liquid fuel flow to the chamber, the metering means being located in the chamber or closely adjacent thereto to minimise volume of fuel between the metering means and the heater means.

4. A vaporiser as claimed in Claim 2, wherein the metering mean includes adjustment means to enable adjustment of the flow of liquid to the metering means.

5. A vaporiser for LPG fuel such as propane or propane/butane mix, having a boiling point of less than 0°C, the vaporiser including gas burner heating means, a chamber for receiving liquid LPG, and a metering means in or closely adjacent to the chamber for limiting the flow into the chamber when heated whereby controlled vaporisation of the fuel to a gaseous state is achieved enabling conventional pressure regulation of the gaseous fuel.

6. An implement fitted with a vaporiser as claimed in Claims 3 to 5, wherein the implement includes gas burners adapted to be supplied with gas from said vaporiser.

7. An implement fitted with a vaporiser as claimed in claims 1 to 3 wherein the implement is fitted with gas jets directed towards the ground surface and including air deflection means adapted to spread gaseous fuel over the ground surface prior to ignition of the fuel.

8. A vaporiser for LPG fuel such as propane or propane / butane gas comprising an elongate tubular member and associated heater means to vaporise liquid fuel in the tubular member, said tubular member including a metering means for admitting fuel to the tubular means having a relatively large orifice or orifices.

9. A vaporiser as claimed in Claim 8, wherein the tubular member includes an orifice at each end and a vaporised gas outlet at a median portion of the tubular member.

10. A burner as claimed in Claims 1 or 2, wherein the gauze or mesh element is mounted adjacent to the burner outlet and is configured concave inwardly of the burner outlet.

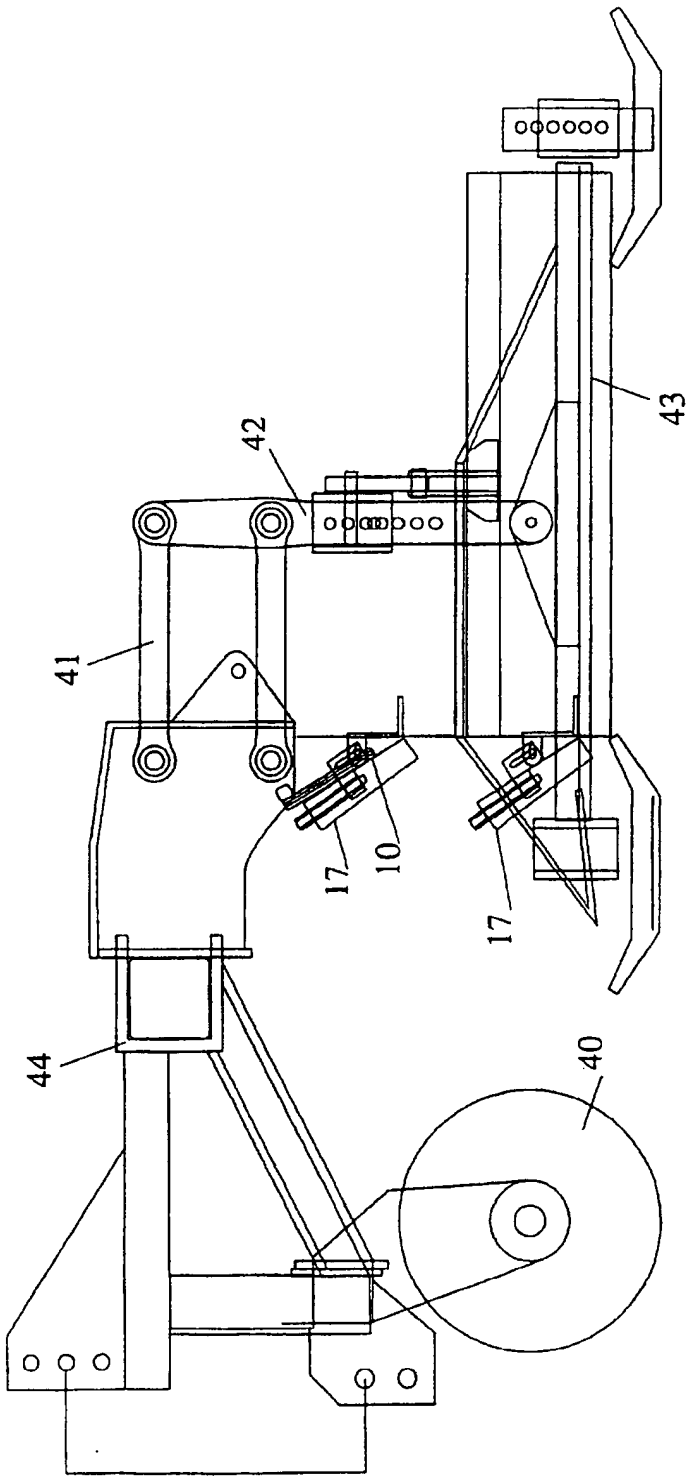


Fig 1.

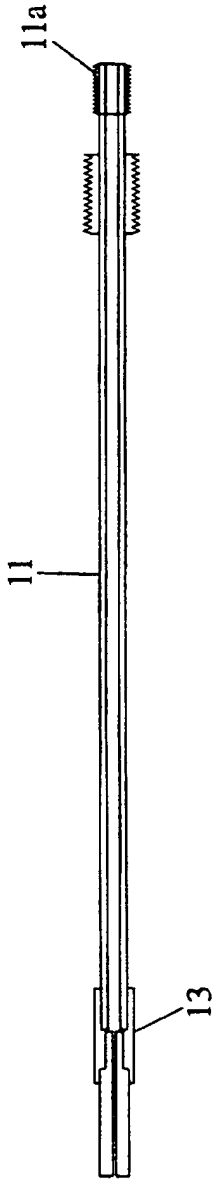


Fig 2.

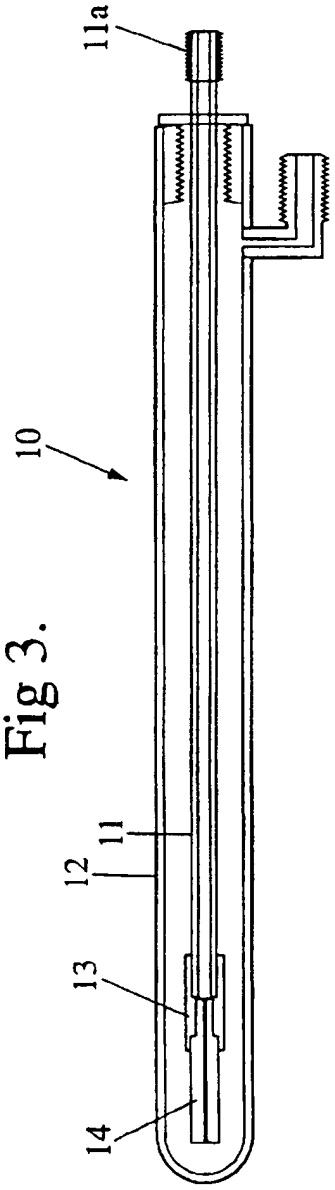


Fig 3.

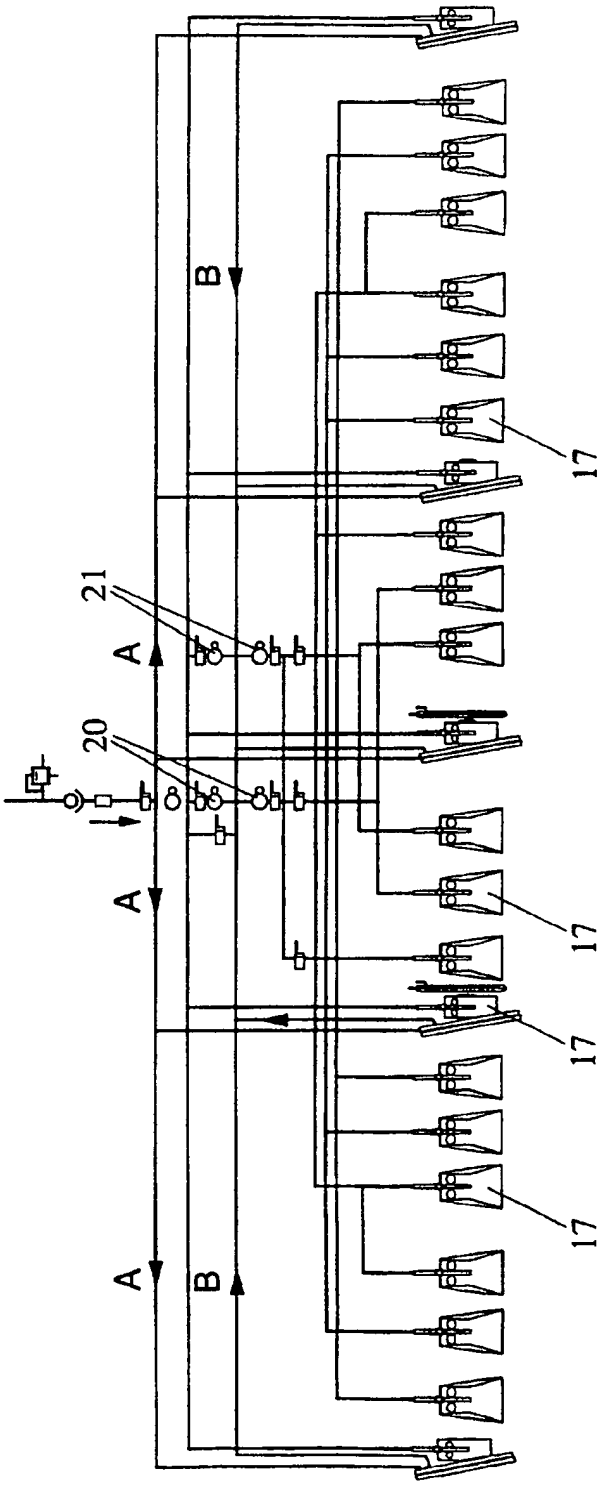
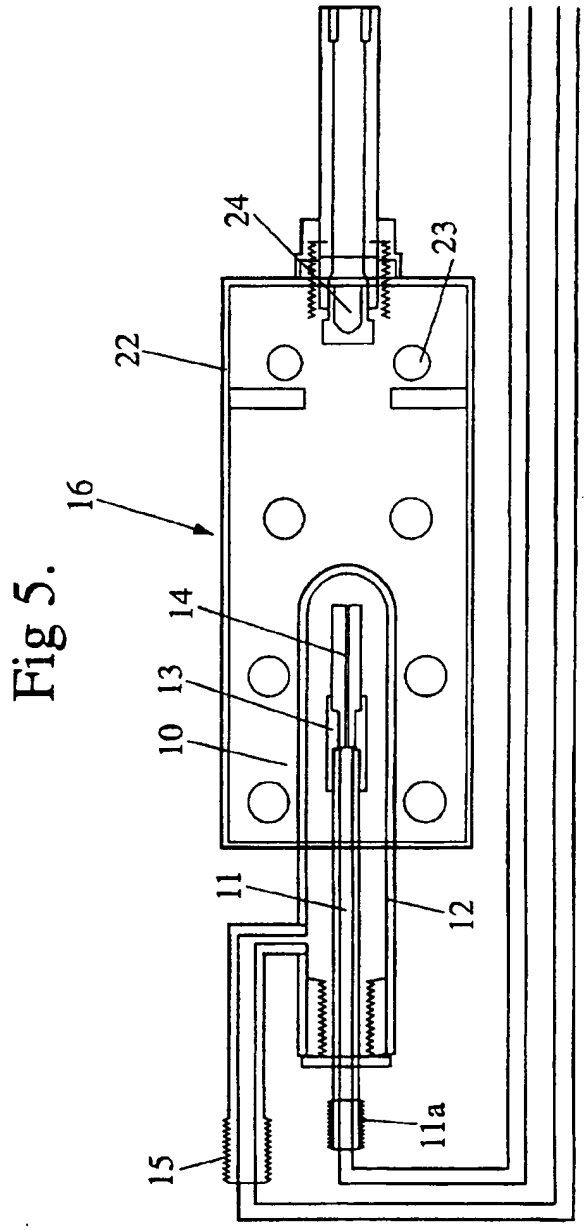


Fig 4.

Fig 5.



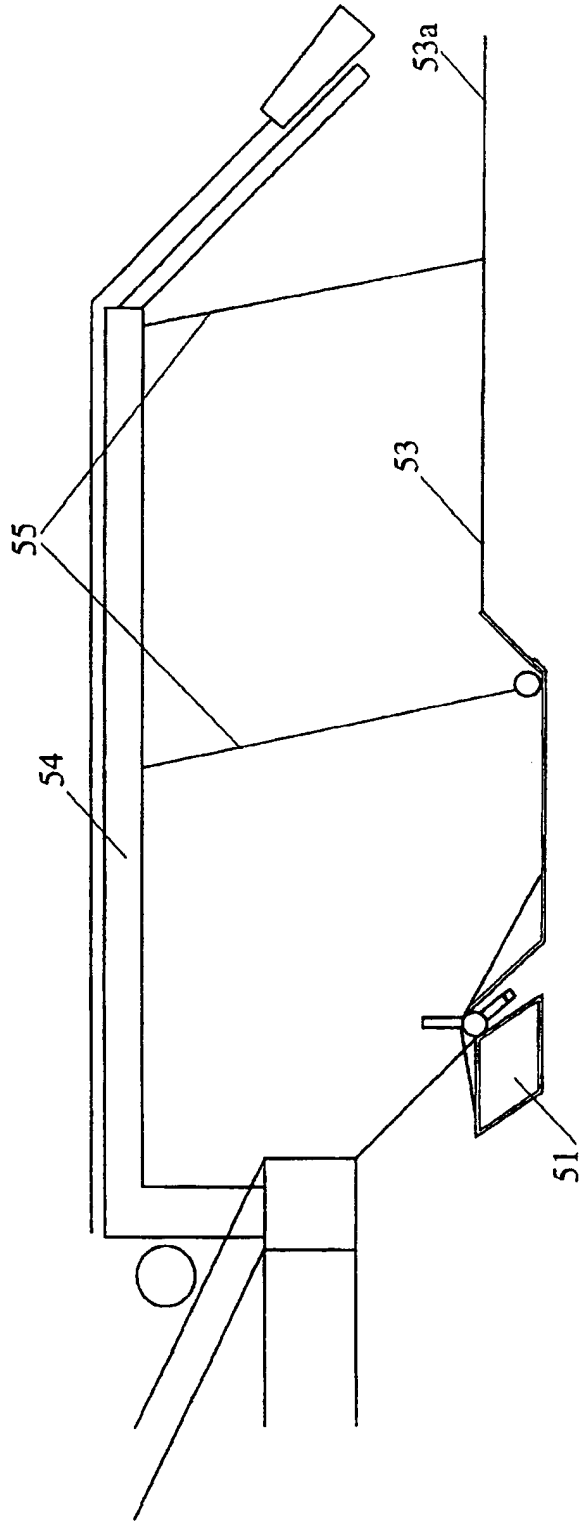
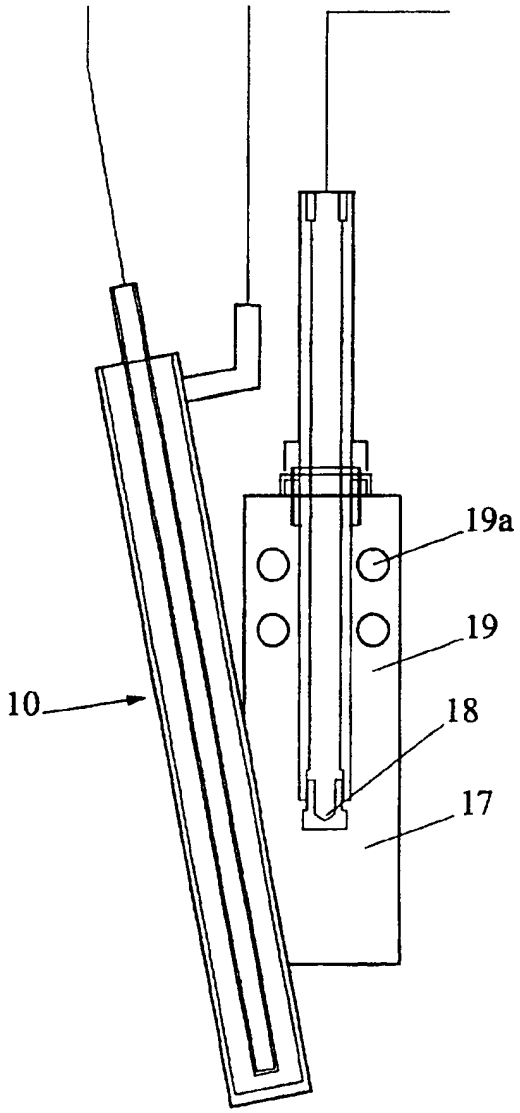


Fig 6.

Fig 7.



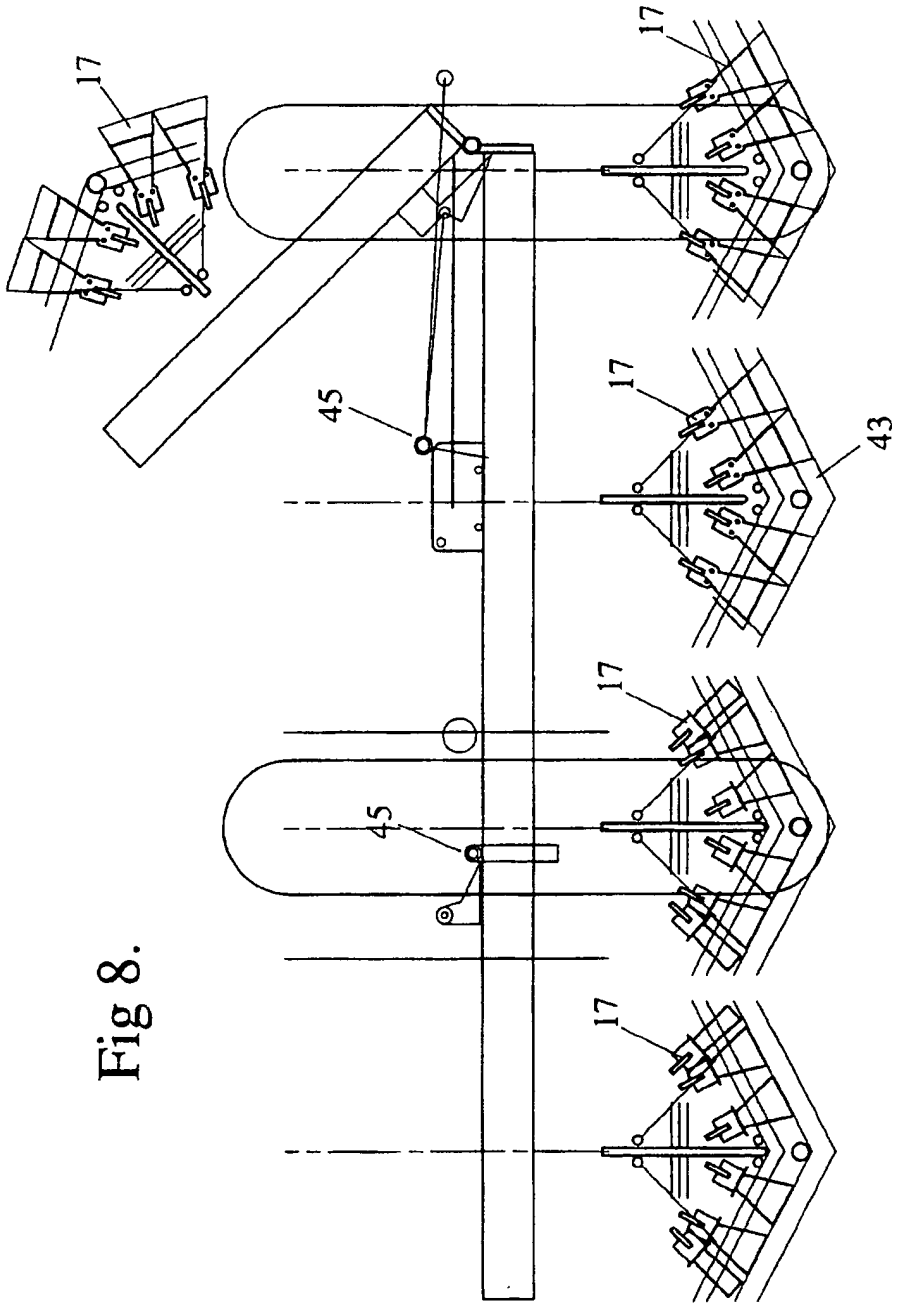


Fig 8.

Fig. 9

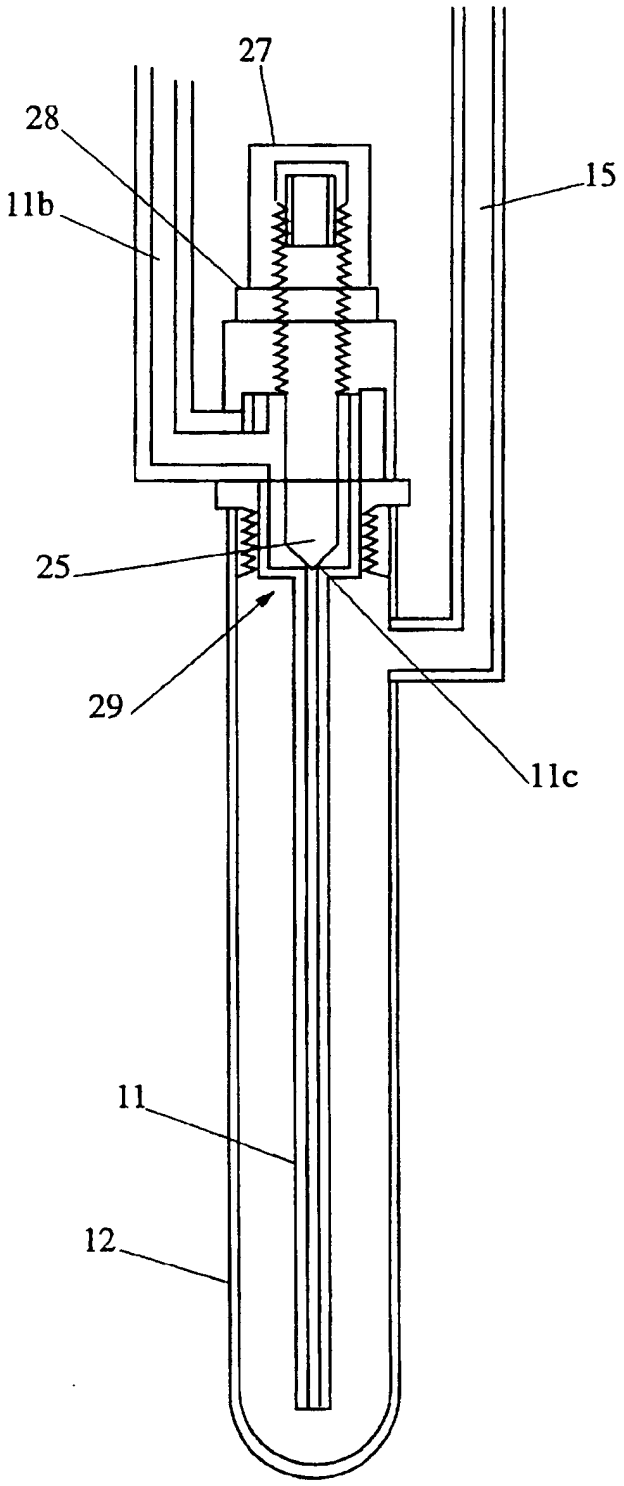
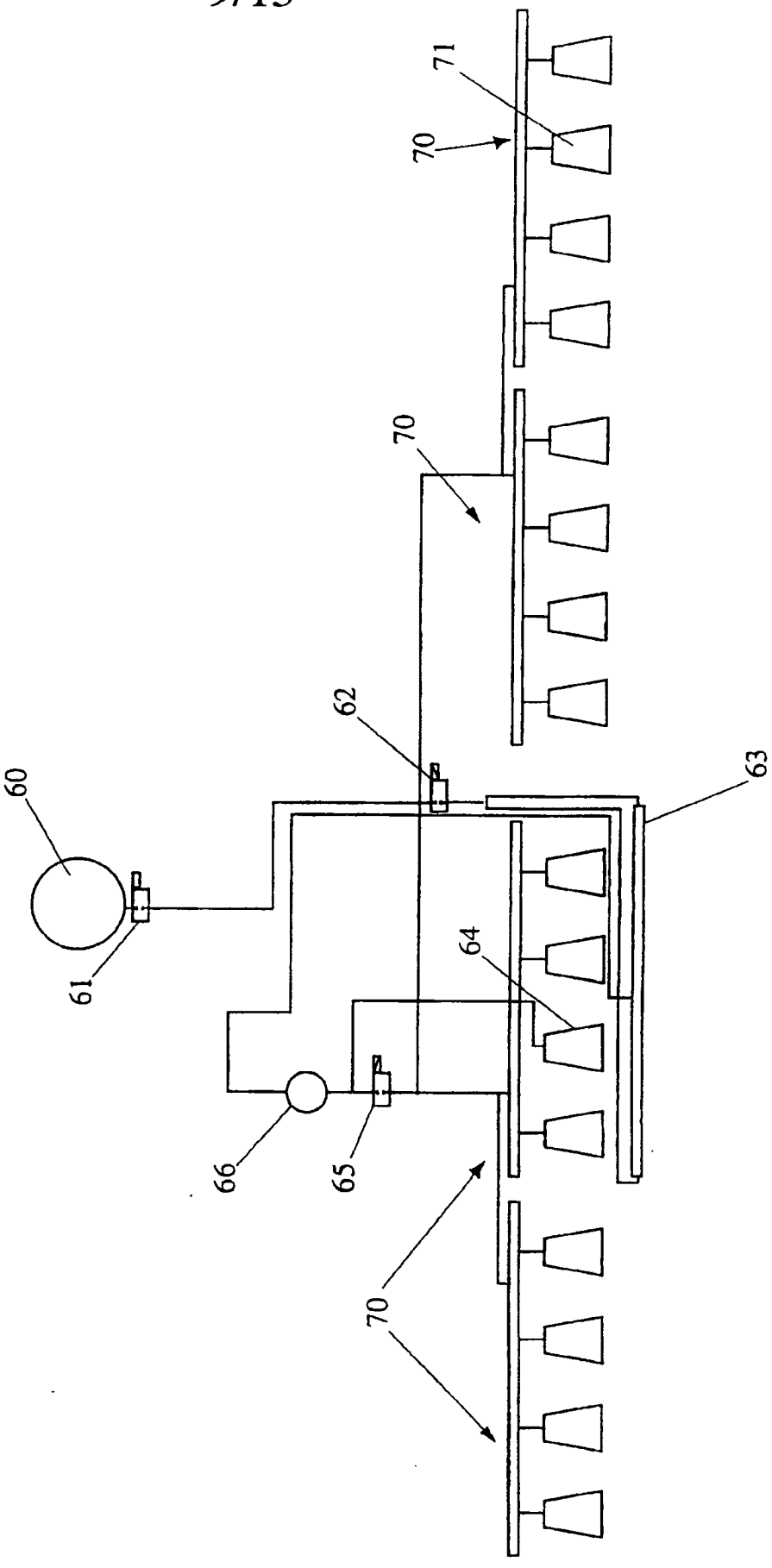


Fig. 10



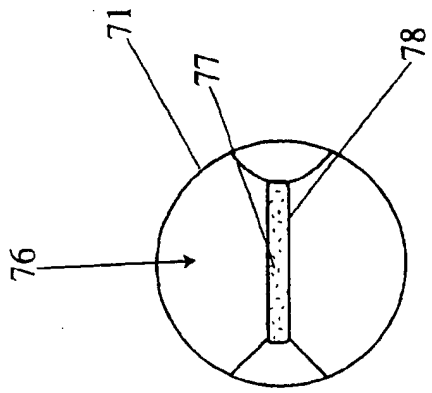


Fig. 12

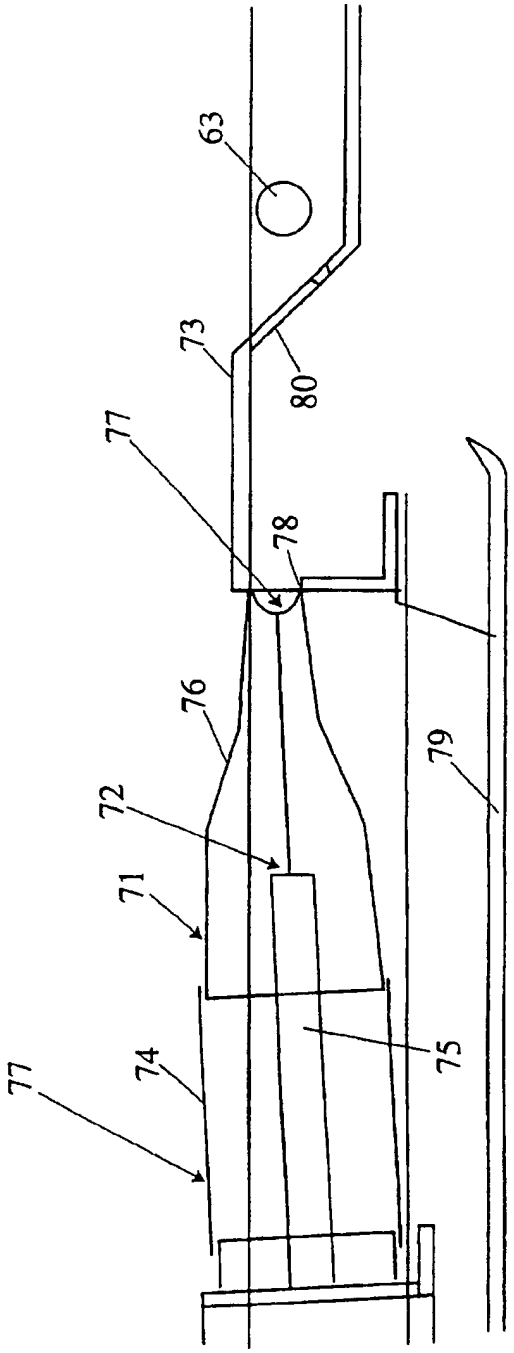


Fig. 11

Fig. 13

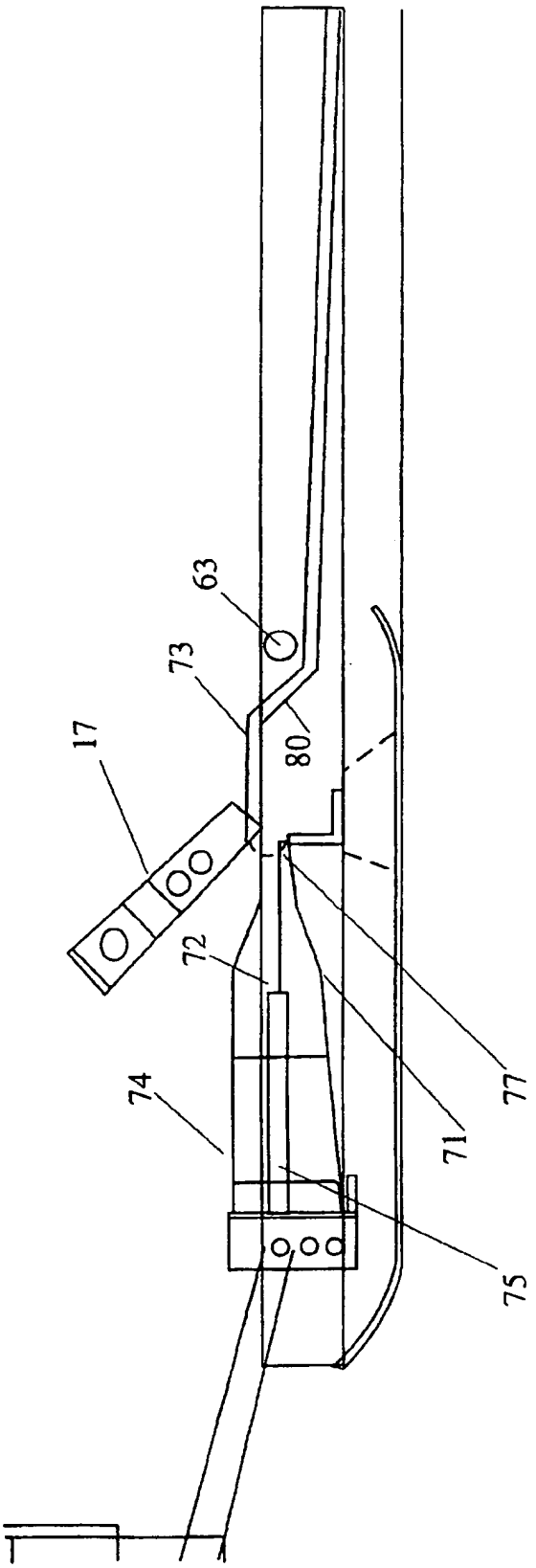


Fig. 14

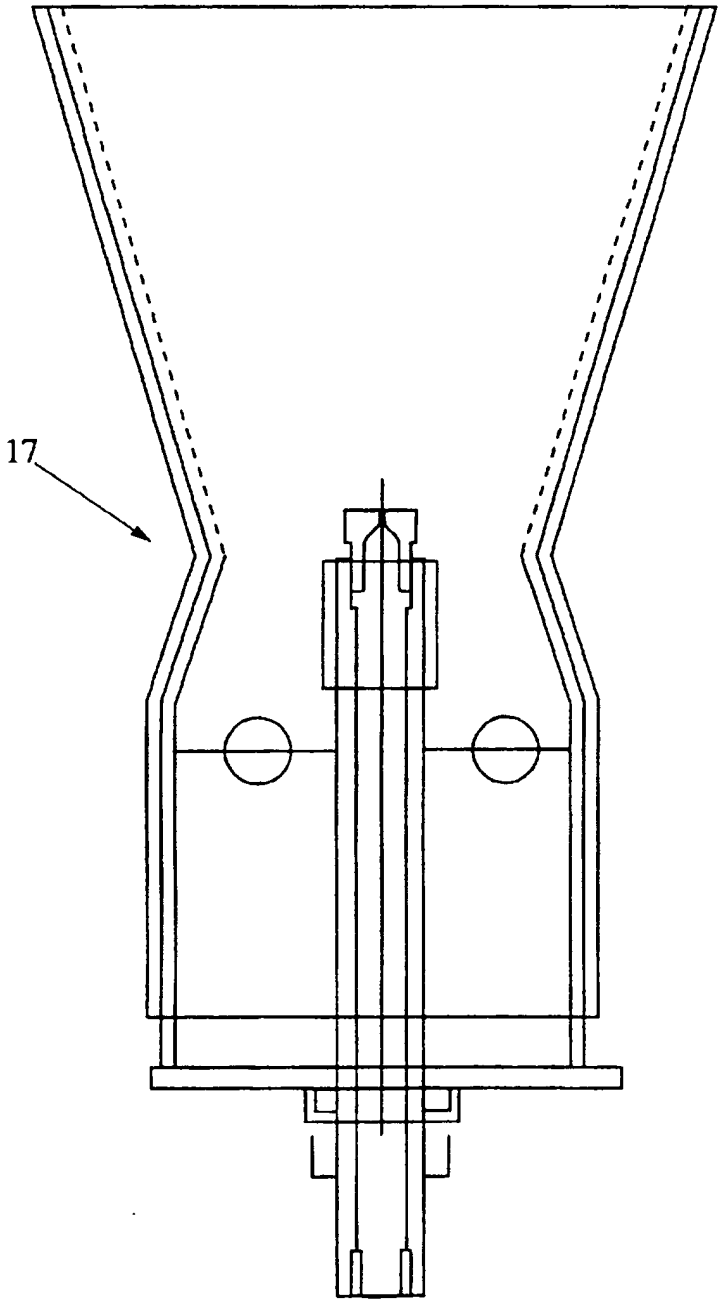


Fig. 15

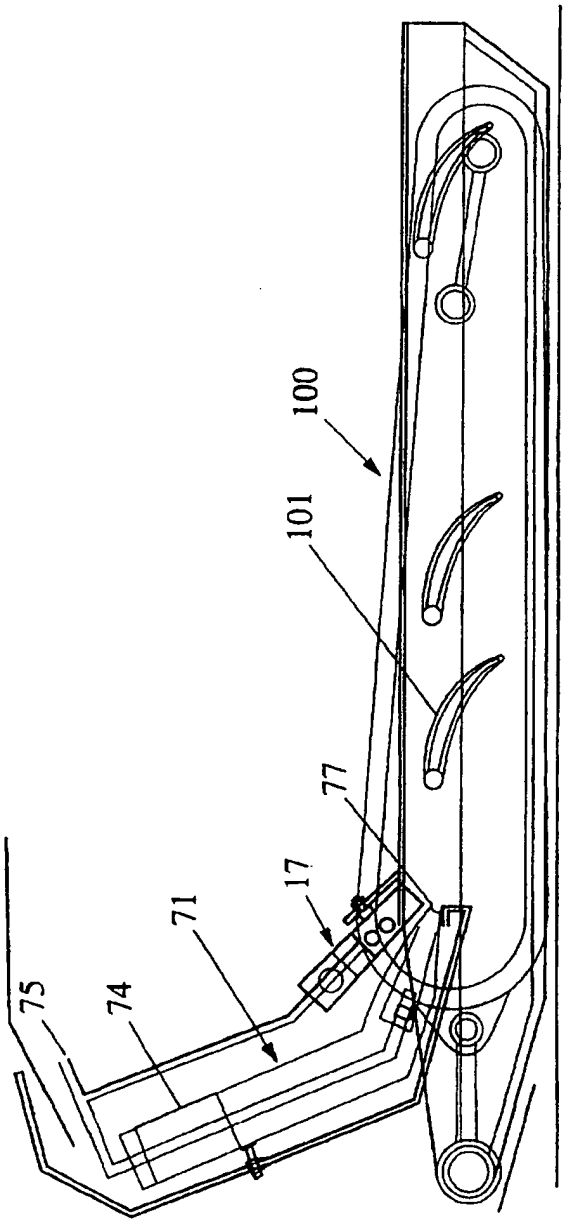


Fig 16.

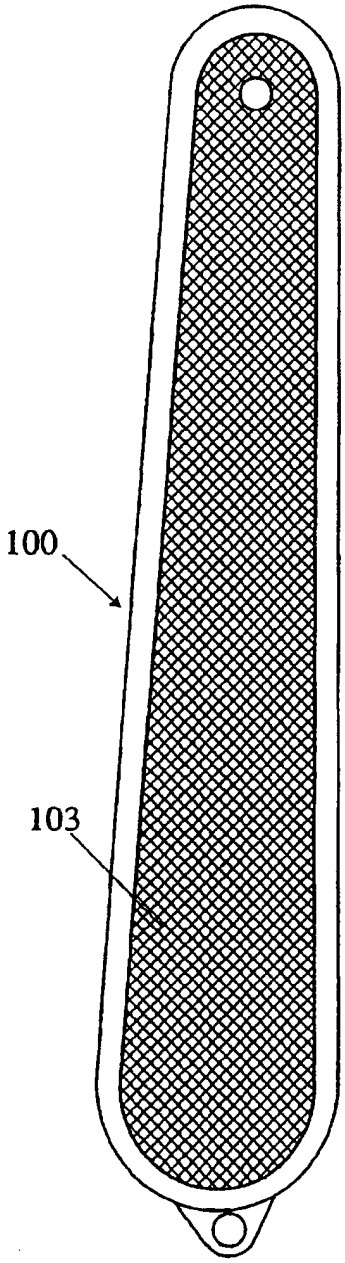


Fig. 17

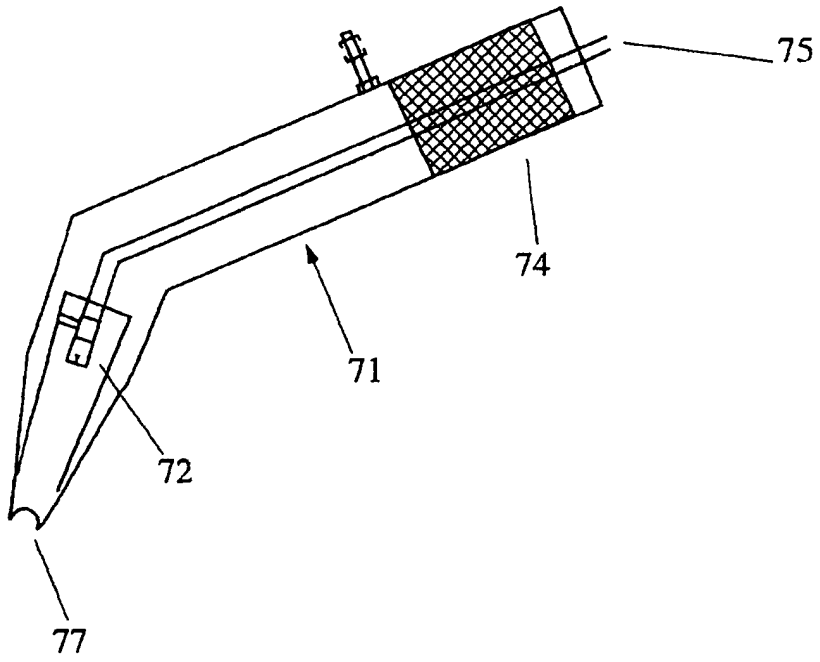
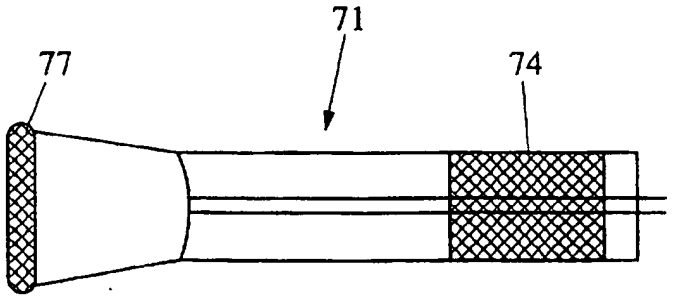


Fig. 18



INTERNATIONAL SEARCH REPORT

International Application No.
PCT/AU 97/00429

A. CLASSIFICATION OF SUBJECT MATTER

Int Cl[6]: A01M 21/04, 15/00; F23D 14/66

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC A01M 15/00, 21/04; F23D 14/48, 14/52, 14/56, 14/66

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
DERWENT

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y	US 4631023A (COURREGE) 23 December 1986 Abstract and figs 1-5	1,7,10 2
X	Patent Abstracts of Japan JP 07-280216 A (CHUGAI RO CO. LTD) 27 October 1995	1,10
X	Patent Abstracts of Japan, JP 07-260111A (MASUTANI KAZUYUKI) 13 October 1995	1

[X] Further documents are listed in the continuation of Box C

[X] See patent family annex

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
5 September 1997	19 SEP 1997
Name and mailing address of the ISA/AU AUSTRALIAN INDUSTRIAL PROPERTY ORGANISATION PO BOX 200 WODEN ACT 2606 AUSTRALIA Facsimile No.: (02) 6285 3929	Authorized officer **S.J. DESCHANEL** Telephone No.: (02) 6283 2368

INTERNATIONAL SEARCH REPORT

International Application No.
PCT/AU 97/00429

C (Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	Derwent Abstract Accession No. 85-274921/44, class Q73, SU 1151767 A (AKSENOV) 23 April 1985	1
Y	US 2531741 A (PECK) 28 November 1950 Column 7 lines 18-35 and fig 6	2
X	US 2188072 A (BROWN) 23 January 1940 Page 1 Right column lines 22-27; page 2 Right column lines 5-7 and figs 1-2 and 7	3-6, 8-9
X	US 2548051 A (PECK) 10 April 1951 Column 3 lines 19-34, column 4 lines 42-47 and fig 2	3-6, 8-9
X	FR 2714260 A1 (GUILBERT-EXPRESS S.A.) 30 June 1995 Abstract, page 5 line 27 - page 6 line 33, page 9 lines 8-37 and fig 1	3-6, 8
X	WO 90/08465 A1 (PRIMUS SVENSKA AB) 8 August 1990 Abstract, page 6 line 19 - page 7 line 6 and fig 1	3-7

INTERNATIONAL SEARCH REPORT

International Application No.
PCT/AU 97/00429

Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

This International Search Report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a)

Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1. Claims 1, 2, 10
Gas burner arrangement for flame control apparatus,

2. Claims 3-9
Vaporiser for LPG fuel,
as reasoned on extra sheet:

1. ☒ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims

2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest.

☒ No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

International Application No.
PCT/AU 97/00429

Box

The international application does not comply with the requirements of unity of invention because it does not relate to one invention or to a group of inventions so linked as to form a single general inventive concept. In coming to this conclusion the International Searching Authority has found that there are two inventions:

1. Claims 1, 2, 10 directed to a gas burner arrangement for a flame, weed and pest control apparatus comprising a burner including a gauze or mesh insert member mounted within and extending across to cover the burner outlet. It is considered that the mounting of the gauze or mesh insert member to cover the burner outlet comprises a first "special technical feature".

2. Claims 3-9 directed to a vaporiser for LPG fuel including a chamber, heater means and metering means for limiting the volume of liquid fuel flow to the chamber. It is considered that the metering means for limiting the volume of liquid flow to the chamber comprises a second separate "special technical feature".

Since the abovementioned groups of claims do not share either of the technical features identified, a "technical relationship" between the inventions, as defined in PCT rule 13.2 does not exist. Accordingly the international application does not relate to one invention or to a single inventive concept.

INTERNATIONAL SEARCH REPORT
Information on patent family members

International Application No.
PCT/AU 97/00429

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report		Patent Family Member			
US	4631023	EP	6048	FR	2427551
FR	2714260	DE	4445587	NL	9402232

END OF ANNEX

CLIPPEDIMAGE= WO009801031A1
PUB-NO: WO009801031A1
DOCUMENT-IDENTIFIER: WO 9801031 A1
TITLE: IMPROVED CONCENTRATED HEAT AGRICULTURAL FLAME CULTIVATOR APPARATUS

PUBN-DATE: January 15, 1998

INVENTOR-INFORMATION:

NAME	COUNTRY
JOHNSTONE, IAN	AU
SMITH, ROBERT	AU

ASSIGNEE-INFORMATION:

NAME	COUNTRY
BORAL GAS NSW PTY LTD	AU
JOHNSTONE IAN	AU
SMITH ROBERT	AU

APPL-NO: AU09700429
APPL-DATE: July 4, 1997

PRIORITY-DATA: AU0PO087796A
AU0PO194796A
AU0PO387996A (July 5, 1996
August 28, 1996
November 27, 1996)
INT-CL_(IPC): A01M021/04; A01M015/00 ; F23D014/66
EUR-CL (EPC): A01M021/04; A01M015/00, F23D014/48 , F23D014/66

ABSTRACT:
CHG DATE=19990617 STATUS=O>An agricultural flame cultivator is disclosed comprising a burner construction of bunsen burner type having a gas inlet, a mixing chamber and burner outlet, the burner outlet including a gauze or mesh member insert bordering the mixing chamber at or near the burner outlet for directing flame into a zone of treatment within the cultivator and an additional burner positioned to direct additional heat into the same zone of treatment to boost heat in the zone of treatment. A vaporiser for LPG gas is also disclosed in which metering means for controlling the flow of liquid fuel into the vaporiser, the metering means being located in the vaporiser chamber

or closely adjacent thereto to minimise the volume of fuel between the metering means and the heating means thus ensuring complete vaporisation of the liquid fuel and allowing conventional pressure regulation of the gaseous fuel. In a modified form, the vaporiser is fitted with a metering means that is adjustable . In a further modified form the metering means includes a relatively large orifice to minimise the risk of blockage. An implement for a flame cultivator is disclosed including deflection foils or vanes useful to direct heated air down to ground level in use.